35. The seal of claim 34 wherein the first portion has an average particle size of about 0.50 micron and the second portion has an average particle size of about 0.17 micron or less.

36. The seal of claim 32 wherein the fibres comprise alumina and the particles comprise alumina or zirconia.

REMARKS

Reconsideration of the application is respectfully requested.

1. Examiner has rejected claim 1-20 as being anticipated by the Miyamichi et al reference (US 5,512,351). Applicant has cancelled claims 1 –20 and submitted new claims 27 – 36.

New independent claim 27 claims a seal for use in a solid oxide fuel cell. The seal as claimed therein is submitted to be novel over the teachings of Miyamichi in at least one fundamental respect. The elements of the seal, as claimed, are not sintered and remain unsintered. The seal is of course flexible as a combination of unfired ceramic material that is not densely packed. The seals remain flexible prior to installation into a fuel cell stack. After installation, the seals remain flexible as they remain compressible.

It is acknowledged that the product taught by Miyamichi combines inorganic fibres and metal oxide powder. However, this product is a prepreg which is a rigid, structural material. The prepreg is said to have similar properties to prepreg incorporating epoxy resins. In this case, in the place of epoxy resins, a matrix composition which includes siloxane polymers, a polymerizable monomer and a cross-linking agent. The prepreg is then cured to harden the matrix. The fine metal oxide particles are densely packed and tightly bound together. The prepreg is said to have "flexural strength of 25-50 kg/mm^{2}" (column 12, line 59).

If the product taught by Miyamichi were used as a seal, it would provide a hermetic, gas-tight seal because of its density.

In contrast, the seal material of the present invention is not fully dense, but rather is porous, compressible and flexible. The fibres and particles of the seals of the present invention are not sintered, coalesced, densified or otherwise bound so as to create a rigid material. No resin is used to bind together the fibres and particles. The material remains flexible and easily compressible as stated in the specification at page 6, line 5. The seal material remains somewhat porous; as a result, the seal provides an effective but not hermetic seal.

It is these properties that permit the seal to solve the problem of the prior art. Brittle and rigid seals in a solid oxide fuel cell crack and breakdown because of vibration, unequal loading and thermal expansion mismatches. The seals of the present invention solve that problem by being flexible and remaining flexible at high operating temperatures. Vibrations and shear stresses are absorbed. This beneficial result is obtained by accepting the compromise of a non-hermetic seal. Gas leakage may be minimized to an acceptable level and the advantages are retained. This is a non-obvious result – it is counter-intuitive to make a seal less effective (non-hermetic).

New independent claim 27 recites limitations which distinguish Miyamichi in this regard and is submitted to be patentable. Claims 28 – 36 depend from claim 27.

2. Examiner has rejected claims 1-8 and 13-16 as being anticipated by the Ohkawa et al reference (US 5,468,351). Applicant has cancelled claims 1 –20 and submitted new claims 27 – 36.

Ohkawa teaches a fibre-reinforced composite material. As stated in Ohkawa (column 2, lines 5 – 14) the material is a:

"...dense matrix material in surrounding relationship to such continuous fiber-reinforcement. As a result, more efficient methods for making composite materials of superior quality are provided. Such consolidation can be carried out by hot-pressing and/or by CVI or the like, employing an appropriate vapourous substance compatible with the impregnated particles to cross-link or lock them into position and thereby create composite materilas of low overall porosity and high strength."

The composite material taught by Ohkawa is similar to the prepreg taught by Miyamichi in this regard. The material is intended to be as dense and strong as possible as the result of a consolidation step which creates a rigid structure. It too would create a hermetic, gas-tight seal.

Again, the comments regarding the contrast between the seal material of the present invention and Miyamichi are repeated here, in response to Ohkawa.

New independent claim 27 recites limitations which distinguish Ohkawa in this regard and is submitted to be patentable. Claims 28 – 36 depend from claim 27.

3. Examiner has rejected claims 1-8 and 13-16 as being anticipated by the Sanocki et al reference (US 5,955,177). Applicant has cancelled claims 1 –20 and submitted new claims 27 – 36.

Sanocki teaches fire barrier material which combines a non-woven mat of fibres and a metal-oxide coating. Applicant points out that the metal oxide coating is only applied to one surface, or a portion of a surface, of the mat and does not infiltrate the mat. Furthermore, the coating is said to be completely inflexible. At column 3, line 58, it is stated that "Coating the entire surface of a fabric typically makes the resultant mat undesirably inflexible, particularly if they have been heat treated." The mat may remain flexible only by coating portions of the mat, not the entire surface.

In contrast, in the present invention, the fibre mat (or matrix, as described in the specification) is impregnated throughout with the particles, as opposed to only being coated with the particles. Claim 27 includes the limitation that the particles are "interspersed" within the fibre matrix. Accordingly, it is submitted that claim 27 and its dependent claims are patentably distinct from Sanocki.

4. Examiner has rejected claims 1-7 and 13-16 as being anticipated by the Mercuri et al reference (US 5,990,027). Applicant has cancelled claims 1 –20 and submitted new claims 27 – 36.

It is submitted that Mercuri teaches a very different material. The flexible graphite sheet consists of expanded graphite particles which have entrapped fibres within the particles. The purpose of the fibres is to create channels within the graphite particle where liquid resin can infiltrate the graphite particle itself. At Column 2, line11, it is stated:

> "Since the needle-shaped ceramic fibre particles are non-reactive and non-adhering to the graphite in the flexible sheet, a plurality of annular channels surrounding the the respective needle-shaped particles is provided... These channel, with the flexible graphite sheet immersed in a liquid resin, recive the resin which then infiltrates the flexible graphite sheet."

Accordingly, the resulting product is characterized by a flexible graphite sheet, formed by pressing expanded graphite particles having entrapped ceramic needles, infused with a resin which enters through channels created by the needle particles in the graphite particles.

The product taught by Mercuri is evidently dissimilar to the seal claimed in the present application.

5. Examiner had rejected 6 and 7 ans being indefinite and including improper Markush language. Examiner had objected to claim 16 because of an informality. Claims 6, 7 and 16 have been cancelled.

CONCLUSION

In view of the foregoing remarks and amendments, it is respectfully submitted that this application is in condition for allowance and allowance thereof is respectfully requested.

Respectfully submitted,

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By: _____
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ATTACHMENTS:

1. Clean Copy of Added Claims

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